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PERSONAL REPORTS ON THE THIRD CONGRESS OF THE INTERNATIONAL
FEDERATION OF AUTOMATIC CONTROL HELD IN LONDON, JUNE 20-25, 1966

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Report by Professor I. Flügge-Lotz

The Third Congress Offered:

1. Survey papers (11 in all, two each day at the beginning of the morning and afternoon activities and one in the concluding session on Saturday). They were transmitted in four languages.

2. Tutorial sessions (4), a new item introduced at this Third Congress.

3. Informal Colloquia (I wanted to attend the last two on Friday on Problems in Theory, [Joint Chairman: Professor J.G. Truxal (USA) and Professor J.H. Westcott (U.K.)].) After a crowd of about 100 had waited for more than half an hour in the room for the morning colloquium, it was announced, without giving any reason, that these colloquia would not take place. This was generally regretted.

4. Films (aimed at audiences of very different levels, showing the advantages of automation). All these films were made for special purposes but not particularly for this Congress.

5. Technical Sessions. The Third Congress introduced a new system of presentation of submitted papers. A "Rapporteur" (reporter) would or should give a résumé of the "highlights and main features" of the papers (half an hour). Then each author (usually six to seven) was allowed five minutes to bring his work up to date. (The papers had been submitted 18 months before the Congress date). Then a discussion could take place; first prepared discussions, in advance announced to the secretary of the session, then ad hoc discussion took place.

The success of a session depended entirely on the ability of the reporter to evaluate the papers and on the ability of the Chairman to restrain some authors and to conduct the discussion.

The admitted languages were English, Russian, German and French. Unfortunately, I found interpreters in only one theory session on Monday; later they were missing. This was particularly regrettable in session 6 on "Continuous Linear Systems" when the well-known Russian, Professor A.M. Letov, gave his report in Russian.

A disadvantage of this system was the impossibility of changing from one session to a parallel session, in order to attend the presentation of a special paper.

I was Chairman of session 24 on "Deterministic Optimal Control". Dr. O.L.R. Jacobs (U.K.) gave a very good report and some papers led to intensive discussions.

Two Chinese papers were announced ("An Iterative Method for Terminal Control and Time Optimal Control Systems", by Tai Ju-Wei and Li Pow-So and "Application of Mechanical Backlash in Automatic Control Systems" by Yang Yin-Di) but none of the Chinese participants appeared. I was told that eight were expected, but a cable the week before the Congress cancelled their reservations. This was an interesting detail, because in 1963 in Switzerland, Chinese delegates appeared and in one case distributed a theoretical paper which they said the Congress had refused to accept. A special meeting for the discussion of that paper was announced, some 20 people (I among them) appeared, but not the Chinese author.

Additional Remarks

General Sessions

Since the writer's work lies essentially in the field of deterministic theory, only comments about theoretical work are made.

The survey papers, particularly V.A. Trapeznikov's (Russia) "Control, Economy, Technological Progress" and J.H. Milsum's (Canada) paper were extremely general.

Trapeznikov's paper might just as well be considered as an application of mathematical methods to a study of a nation's economy based on statistical material and prediction. The laws used were of such a general form that one felt sent back in the early time of atom theory, where speculation more than detailed knowledge prevailed. Milsum's paper will soon be published in a half scientific, half popular journal, as I understand.

J.H. Westcott's (U.K.) paper on the status of control theory shows a fine knowledge and an attempt to critically view the status of different disciplines in control and system analysis. However, this reviewer cannot agree with certain opinions of Westcott about mathematical details; for instance, a remark, when discussing Pontryagin's maximum principle "although we are still left with the adjoint variables, those rabbits produced from the hat with no obvious motivation". Perhaps there the practical engineer's uncomfortable feeling with some longtime tools of the mathematician comes up. But overall his paper is very worthwhile reading.

This participant was impressed by Y.Z. Tsypkin's paper on "Adaption, Learning and Self-Learning in Control Systems", but would prefer to leave an evaluation to a man like Professor B. Widrow (Electrical Engineering, Stanford University).

Technical Sessions

The number of theoretical papers from USA and USSR was much larger than the number of papers of other nations. This indicates that in these nations a very strong effort is evident in the control field. Naturally, next numerous were the papers from the United Kingdom and the neighboring countries of the European continent.

Optimal Control Theory stands no longer in the first place; it is evident that people have found out that the realization of time optimal control is difficult and therefore a rather large number of iteration procedures (optimizations) were offered. Unfortunately they were mostly not accompanied by really interesting examples. This may partially be due to the fact that the papers had to be submitted 18 months in advance and that people offered their schemes in the hope later to find time to test them at more than the simplest examples.

Two papers should be mentioned for their special topic, one by Dr. A. Strascak, Poland, who studied optimal control by adding to the performance criterion a controller cost constraint. Unfortunately no practical example was given. A Japanese paper by M. Masubuchi, T. Sekiguchi, H. Kanoli, Y. Kawashima and M. Matsui drew attention to the fact that Pontryagin's Maximum Principle gives only necessary conditions and not sufficient conditions; the latter fact may be of great importance in nonlinear control problems. The paper gave examples without sufficient explanation and reporter and Chairman (myself) were not able to get more information because of language difficulties.

It became apparent that the control of systems described by partial differential equations attracts more and more attention. (This is usually called control of systems with distributed parameters.)

Papers concerning aerospace problems (session 33 and 39) were predominantly from the USA.

Report by Professor J.V. Breakwell

The writer was co-author, with F. Tung, of paper No. 39B, "An Optimal Information and Control Policy in Interplanetary Guidance".

After an excellent summary by Dr. R.N.A. Plimmer (Royal Aircraft Establishment) of this and the other papers in session 39, I referred to some recent theoretical work by a student at the University of Canterbury (New Zealand) which casts doubt on the optimality of certain strategies proposed in paper 39B.

After the end of the session, some interest was shown in paper 39B by B.N. Petrov (USSR), but unfortunately the language barrier was nearly insuperable.

At another session, I conversed rather briefly with the author of paper 19A, K.A. Lurie (USSR), a very impressive young Russian who is also a first-rate linguist.

During the week following the Congress, I visited ONERA, just south of Paris, to discuss recent results in optimal orbit transfer with C. Marchal and J.P. Marec, protégés of Dr. P. Contensou, the expert. They are not only very much up-to-date on what has been done, but are continuing to obtain new results, emphasizing analytic rather than numeric methods. I was also given a courtesy tour of the ONERA wind-tunnels by Dr. Contensou, who is the Technical Director of ONERA.

I also spent an afternoon at ELDO, at the invitation of R. Cosaert. Dr. Cosaert is quite up-to-date on the application of optimal filter theory to orbit determination, but is anxious to take advantage of numerical experience (stability, speed of convergence) obtained in the USA.

Report by Professor R.H. Cannon, Jr.

I was co-author with Captain J.F. Schaeffer, of paper 6C, "On the Control of Unstable Mechanical Systems," participated (as a member) at the meeting of the IFAC Committee on Space, and of course attended many of the general and technical sessions, speaking as often as possible with European and Asian specialists. (I had been asked to serve as a Session Chairman, but could not accept because of uncertainties in my plans at the time scheduling was being worked out.)

Survey Papers

The survey-paper concept is excellent and indispensable in this tri-annual conference, in my opinion. The intent is for an expert with lots of perspective to discuss the state of the art in a special field -- industrial control, adaptive learning, computer design -- for the benefit of control workers not specializing in that field. Some of the survey papers certainly failed to live up to their potential, but some were quite good and most helpful. My favorite was by Professor Milsum (McGill University) on "Automatic Control and Medicine". His coverage and explanation by example were most helpful to me, although I am not competent to judge the depth of his presentation. This would seem to be one of the most exciting applications of the control art, if indeed that art can be effectively brought to bear on the problem from its current equally distant facets of abstract theory and of application to much simpler physical systems.

My reaction to Professor Wescott's paper is quite similar to Professor Flügge-Lotz's. It was thought provoking.

Technical Sessions

Dr. John Aseltine was rapporteur for session 33, and did a most competent but straightforward job. Some familiar people presented extensions, for the most part of familiar earlier work. Lange and Fleming apply their control synthesis method for frequency symmetric plants to satellite attitude control, satellite orbital guidance, and satellite libration-point control. Stallard extends the Honeywell limit-cycle method of adaptive control. Nicklas et al consider on-off control of space-vehicle attitude wherein the rate gyro is replaced by a state estimator, in two of the three axes. Ives presents a variation on the control-moment-gyro attitude-control scheme for damping the motion of gravity-gradient satellites. Much earlier work has been recorded by five or six groups, including Ives' group at the Royal Aircraft Establishment and also the writer (IFAC 1963). Merrick and Moran generalize earlier excellent work, by themselves and others, on the use of external booms for good gravity-gradient control of earth-pointing satellites. Not much controversy in the discussion here. (The comments by one discussor of Ives' paper showed that the discussor did not understand the principle involved; he was appropriately set straight.)

At least three of the papers in session 39 are significant: 39D by Hempel, 39C by Bona and du Plessis, and 39B by Breakwell and Tung. Hempel's work may lead to useful simplification of rendezvous-guidance logic. Bona and du Plessis present a practical, rather sophisticated, highly useful application of optimal-filter theory to inertial guidance. Breakwell and Tung continue their structuring of the problem of control policy for interplanetary guidance. Breakwell's modest reply to criticism from New Zealand (see Professor Breakwell's report) provided enjoyable entertainment and motivation.

Roberson and Wittenberg (session 46) suggest a formalism for writing the equations of motion of multi-body satellites. Others in the field have done similar work (Hooker and Margulies; DeBra, Scott, and Weiten; and Yu). It is good to have this published paper by Roberson and Wittenberg. I think considerable further evolution will come from several quarters. A notation which has evolved at Stanford should eliminate certain ambiguities, for example.

Cannon and Schaeffer livened up session 6 a bit, during "the author's five minutes," with a film demonstrating our theory for controlling unstable systems: demonstration is with a cart that can balance two sticks at a time -- side by side or one atop another -- as well as a highly flexible beam. This work, sponsored in part by NsG 133, drew gratifying comments from a number of quarters. Four papers in session 6 -- 6D by Sivan (Israel), 6E by Gilles (Darmstadt), 6F by Filipovic (Yugoslavia) and 6G by Solheim and Saegher (Norway) deal with control of distributed-parameter systems, and indicate the widespread beginnings of work in this important and difficult area. Kalman's paper, 6A, drew much fire, mostly from Russians. This may be related to Kalman's attack on a Russian paper the previous day (which I did not hear, but which was reportedly incisive). Kalman's rebuttal was tutorial and philosophical. For the discussion, we had translators. For the report by Professor Letov, unfortunately, there was none. (In later conversation, Professor Letov alleged that he had called our paper "most elegant" and described seeing our experimental equipment on his visit to Stanford.)

Format

As Professor Flügge-Lotz has commented, detailed arrangements seemed to have been made with less care and (apparently) interest than at Basel. Interpreters were generally unavailable (except at the general sessions), projectors and projectionists had often not been arranged for, etc. The unexplained cancellation of informal colloquia was most regrettable; I expected these to be most useful. However, the spirit of the delegates seemed high, and difficulties were often surmounted one way or another.

The rapporteur system occasionally worked well, but generally left much to be desired: a rapporteur, even an astute one, can seldom capture the enthusiasm of the researcher himself and bring the subject alive for the listener. (Admittedly, of course, many researchers are rather dead speakers also.) Professor Letov's rapporteuring appeared lively; it would have been interesting to know what he said.

The principle objective of the format was occasionally achieved very well, however: a member of the audience would challenge an author, specialists from four or five countries would jump into the fray, and the ensuing discussion would be much more enlightening than the written paper, continuing into lively small-group discussions through lunch, etc. Hopefully a more direct method of achieving this desirable result will be worked out for future congresses. At a meeting late in the week, the theory committee voted unanimously to abandon the rapporteur system.

As always, the most important room was not where the sessions were held, but where the coffee and tables were available. Ad hoc discussions here with good people from many countries were the most valuable part of the Congress.

Meeting of the Committee on Space

This Committee was set up as a result of conversations among several of us at Basel in 1963 regarding the desirability of IFAC sponsoring a small invited international meeting of specialists on space control and guidance. The first such meeting was held at Stavanger, Norway, in 1965. It drew some good people, particularly from USA, and was most beneficial for the interchange among them. My feeling is that it did not, however, accomplish the objective of forcing the Russians to open up.

At the London committee meeting, to dramatize the situation, the writer introduced a resolution which would have required that only experimental papers be accepted. This impulse produced a large abrupt response from Professor Naumov (a Russian theoretician) followed by a sustained limit-cycle oscillation. The Russian counterproposal was to expand the committee's sphere of interest to all modes of transportation (undersea and surface, as well as air and space).

After some discussion, the next Space symposium was scheduled for a resort village near Vienna, September 4-8, 1967. However, if the Russian view prevails, my personal opinion is that the symposium will be watered down to the point that its most important function will be lost.